REMARKS

This application has been carefully reviewed in light of the Office Action dated January 23, 2003. Claims 14 and 40 have been canceled. Claims 1, 2, 6-8, 13, 21, 23, 25, 36-37, 39, 41 and 64 have been amended. A marked-up version of these claims, showing changes made, is attached hereto as Appendix A. Claims 1-13, 15-25, 36-39, 41-46 and 64-70 are now pending. Applicant respectfully requests reconsideration of the above-referenced application in light of the amendments and following remarks.

Claims 2, 6-7, 13-14, 21, 23, 25 and 36-46 stand rejected under 35 U.S.C. §112, second paragraph, as allegedly being indefinite.

Out the outset, Applicant respectfully submits that, generally speaking, self-aligned contact (SAC) openings and methods of formation are well-known in the art (Applicant's specification, page 2, lines 10-18 and Figs. 1-2), as are sidewall spacers and methods of formation (Applicant's specification, page 1, line18 through page 2, line18 and Figs. 1-2).

Nonetheless, for purposes of expediting prosecution, claims 14 and 40 have been canceled. Claims 2, 6-7, 13, 21, 23, 25, 36-37 and 39 have been amended to correct any perceived indefiniteness. No reason has been given as to why claims 38 and 41-46 are indefinite.

Accordingly, Applicant respectfully requests that all § 112, second paragraph rejections be withdrawn.

Claims 1, 3, 8-12, and 15 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Smolinsky. Reconsideration is respectfully requested.

At the outset, Applicant respectfully disagrees with the Office Action's assertion that " 'consisting essentially of' is construed as equivalent to 'comprising.'" In support, the Office Action cites In re Herz, 537 F.2d 549, 551-52 (CCPA 1976) and M.P.E.P. §

2111.03. In re Herz does not stand for such a broad proposition as the Office Action asserts.

For instance, "[t]he transitional phrase 'consisting essentially of' limits the scope of a claim to the specified materials or steps and those that do not materially affect the basic and novel characteristic(s) of the claimed invention." M.P.E.P. § 2111.03 (emphasis in original). Further, "to determine the steps included versus excluded the claim must be read in light of the specification . . . [I]t is an applicant's burden to establish that a step practiced in a prior art method is excluded from his claims by 'consisting essentially of' language." Ex Parte Hoffman, 12 USPQ2d 1061, 1063-64 (Bd. Pat. App. & Inter. 1989).

In the 'Background of the Invention' section of Applicant's specification, it discloses previous attempts to prevent etch stop during contact opening formation. Applicant teaches that, in the prior art, when fluorocarbons and additional etchants, such as ionic or neutral etchants, were used to form contact openings, a thin polymer layer 29 would result at the bottom of the SAC opening 27, e.g., an etch stop (Page 2, line 20 through page 3 line 5 and Figure 2). In addition, oxygen and nitrogen were also added to the prior art fluorocarbon etchant mixture in an attempt to eliminate etch stop with little success (page 3, lines 10-20).

One of the basic and novel characteristics of Applicant's claimed invention is the elimination of etch stop. In order to solve this problem, Applicant's specification teaches that "[t]he fluorocarbon(s) and ammonia are introduced into the reaction chamber at a flow rate which will both allow formation of the self-aligned contact (SAC) opening 27 and prevent or reduce etch stop problems." (Page 8, lines 18-20) (emphasis added). Applicant's specification also teaches that "the combination of at least one fluorocarbon, together with ammonia, is not only effective in forming the contact opening 27 shown in Figure 3, but is also effective in mitigating against etch stop, i.e. the problem illustrated in Figure 2." (Page 8, lines 5-8) (emphasis added).

Accordingly, Applicant's claimed invention excludes any additional neutral etchants, ionic etchants, oxygen, or carbon added to the fluorocarbon etchant mixture. In other words, Applicant's teach an etchant mixture consisting essentially of at least one fluorocarbon and ammonia, which is used to form a contact opening and eliminate etch stop. The novelty of Applicant's claimed invention is the omission of other etchants used to form a contact opening such as ionic or neutral etchants, and carbon and oxygen. Any additional etchant gas which is used to etch an opening in the prior art is excluded as supported by Applicant's specification.

Applicant respectfully submits that Smolinsky fails to anticipate the present invention. Smolinsky is directed at increasing the etching rate of silicon oxides with the "addition of 4% by volume of NH_3 to the CHF_3 feed [which] dramatically alters the etching capabilities of the discharge." (Smolinsky, page 1037) (emphasis added). In particular, Smolinsky teaches only that "NH_3/CHF_3 plasma proves to be a superior etchant for SiO_2 or P-glass on poly-si." (Smolinsky, page 1038).

Smolinsky fails to teach a method for forming a contact opening in an insulative layer, said method comprising an "etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon so as to form said contact opening, wherein the flow rate ratio . . . is from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as claim 1 recites (emphasis added).

The Office Action asserts that Smolinsky teaches "the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1 (4% NH_3/CHF_3)." (Office Action, page 4). In contrast, Smolinsky specifically teaches "the addition of 4% by volume of NH_3 to the CHF_3 feed" and not a flow rate ratio of "2:1 to about 40:1," of fluorocarbon to ammonia as recited in claim 1. Moreover, Smolinsky does not teach that the "flow rate of said ammonia is at least about 2 sccm," as further recited in claim 1. Accordingly, Smolinsky does not anticipate the claimed invention.

Claims 3, 8-12, and 15 depend from and incorporate all of the limitations recited in independent claim 1. For at least the reasons given above, claims 3, 8-12, and 15 are similarly allowable along with claim 1.

Moreover, claim 15 recites "that the flow rate ratio of said at least one fluorocarbon-to-said-ammonia-is-not-less-than-about-3:1." Smolinsky does not teach this processing condition. This is an additional reason for the allowance of claim 15.

Claims 1, 3-12, 15-18 and 20-23 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Ding. Reconsideration is respectfully requested.

Applicant respectfully submits that Ding fails to anticipate the present invention. Ding teaches an etching composition comprising of at least three different gases. Specifically, a fluorohydrocarbon gas, an NH_3-generating gas, and a carbon-oxygen gas (Col. 5, lines 46-55).

Applicant's claimed etchant mixture consists essentially of two etchants: a fluorocarbon gas and ammonia. Ding teaches a third etchant gas. Moreover, Ding does not teach that the "flow rate of said ammonia is at least about 2 sccm." Therefore, Ding does not anticipate the claimed invention and withdrawal of the § 102 rejection is solicited.

Claims 3-12, 15-18 and 20-23 depend from and incorporate all of the limitations recited in independent claim 1. For at least the reasons given above, claims 3-12, 15-18 and 20-23 are similarly allowable along with claim 1.

Claims 1-18, 20-25, 34-46 and 64-70 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Park in view of Smolinsky. Reconsideration is respectfully requested.

Applicant respectfully submits that the cited combination of references fails to render obvious the claimed invention. Park discloses a method of plasma etching an oxide layer with three different etching gases. The first gas is a main etch gas, the second gas is

used as an angle adjusting gas, and the third gas has a very high C/F ratio (Col. 3, lines 49-56). Smolinsky teaches the effect of adding nitrogen or ammonia to only a CHF_3 discharge (Smolinsky, pg. 1036).

There is no motivation to combine Park with Smolinsky. Smolinsky teaches a two-composition mixture; whereas, Park requires three different gases to etch the oxide layer (See Col. 3, lines 40-46). Park does not teach or suggest that ammonia or any other gas can be substituted in lieu of the gas combinations disclosed, let alone in the particular flow rate ratio as claimed by the Applicant. Park also does not teach or suggest that the flow rate of ammonia at least about 2 sccm. Moreover, even if Park can be properly combined with Smolinsky, four different gases would be used to etch Park's oxide layer. Applicant claims a two-etchant mixture consisting essentially of at least one fluorocarbon and ammonia.

The Office Action asserts that "it would be obvious to combine the teaching of Smolinsky to the process of Park et al with motivation as taught by Smolinsky – increasing etch rate." (Office Action, page 15). However, Applicant's claimed invention is directed at a method for forming a contact opening that eliminates etch stop. Applicant's claimed invention is not directed to increasing the etching rate in forming the contact opening. Therefore, there is no motivation to combine the cited references because Park and Smolinsky do not teach or suggest rectifying the problem that Applicant's claimed invention solves: eliminating etch stop in forming a contact opening.

Accordingly, the cited references fail to teach or suggest "an etching composition consisting essentially of ammonia and at least one fluorocarbon . . . [with a] flow rate ratio . . . from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as claim 1 recites, or "etching an opening . . . using a combination consisting essentially of ammonia and at least one fluorocarbon . . . wherein the flow rate ratio . . . is from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as recited by claim 36, or using a "plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon . . . so as to form a self-aligned contact

opening . . . [with a] flow rate ratio of . . . from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as recited by claim 64.

Dependent claims 2-25 incorporate all of the limitations of independent claim 1, dependent claims 37-39 and 41-46 incorporate all of the limitations of independent claim 36, and dependent claims 65-70 incorporate all of the limitations of independent claim 64, and are allowable for at least the reasons provided above for independent claims 1, 36 and 64.

Claim 19 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Park in view of Smolinsky and in further view of Blalock. Reconsideration is respectfully requested.

For at least the reasons provided above, Park and Smolinsky do not render claim 19 obvious. In particular, Park teaches utilizing three different gases to etch an oxide layer. Applicant's claim an etchant mixture consisting essentially of two etchants to form a contact opening. Claim 19 depends from and incorporates all of the limitations of independent claim 1 and should be similarly allowable. Blalock adds nothing to rectify the deficiencies associated with Park and Smolinsky.

Claims 1-25, 36-46 and 64-700 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tan in view of Ding. Reconsideration is respectfully requested.

Tan and Ding are not properly combinable. Tan discloses forming a "self-aligned contact by using different etching rates to two materials of the spacer and cap layer." (Col. 2, lines 23-26). Tan also teaches that an undoped dielectric layer 114 is ion implanted in forming the self-aligned contact opening (Col. 2, lines 49-54). The surrounding dielectric layer not etched to form the contact opening remains undoped. The undoped dielectric layer prevents further etching in further wet etching sequences. The presence of the undoped dielectric layer is an important feature of Tan's invention. Thus, Tan teaches away from forming a contact opening in surrounding doped layers. In

contrast, as discussed above, Ding teaches using three gases to etch a dielectric layer that is entirely doped. Tan's layer 114b is not doped and "has better ability to prevent loss due to the wet etching." (Col. 3, lines 56-59). Accordingly, the references are not properly combinable.

Moreover, even if the references were combined as asserted in the Office Action, the combination would still fail to suggest the invention defined by any of claims 1, 36, and 64. In particular, the cited references fail to teach or suggest "an etching composition consisting essentially of ammonia and at least one fluorocarbon . . . [with a] flow rate ratio . . . from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as claim 1 recites, or "etching an opening . . . using a combination consisting essentially of ammonia and at least one fluorocarbon . . . wherein the flow rate ratio . . . is from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as recited by claim 36, or using a "plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon . . . so as to form a self-aligned contact opening . . . [with a] flow rate ratio of . . . from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm," as recited by claim 64.

Claims 2-25 depend from and include all of the limitations of independent claim 1 and are allowable for at least those reasons provided above with regard to claim 1. Claims 37-46 depend from and include all of the limitations of independent claim 36 and are allowable for at least those reasons provided above with regard to claim 36. Claims 65-70 depend from and include all of the limitations of independent claim 64 and are allowable for at least those reasons provided above with regard to claim 64.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

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APPENDIX A

1. (three times amended) A method of forming [an] a contact opening in an insulative layer formed over a substrate in a semiconductor device, said method comprising:

etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon so as to form said contact opening, wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm.

2. (amended) The method of claim 1, wherein said method is performed to produce a self-aligned contact opening, said opening is self-aligned between two adjacent gate stack structures with side wall spacers.

6. (amended) The method of claim 4, wherein said [contacting] etching is performed at an operating pressure of about 25 to about 60 milliTorrs.

7. (amended) The method of claim 4, wherein said [contacting] etching is performed at an operating pressure of about 40 to about 50 milliTorrs.

8. (amended) The method of claim 1, wherein said [contacting] etching is performed through a patterned photoresist mask.

13. (amended) The method of claim [12] 2, wherein said [method does not remove side wall spacers which are formed along the sides of a gate stack and which align said contact opening to said substrate] side wall spacers remain unetched during formation of said self-aligned contact opening.

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21. (amended) The method of claim 18, wherein said [fluorocarbon] CF_4 is flowed into a reaction chamber at a flow rate of about 18 sccm.

23. (amended) The method of claim 22, wherein said [fluorocarbon] CHF_3 is flowed into a reaction chamber at a flow rate of about 40 sccm.

25. (amended) The method of claim 24, wherein said [fluorocarbon] CH_2F_2 is introduced at a flow rate of about 13 sccm.

36. (three times amended) A process for forming an opening in an insulative layer formed over a substrate in a semiconductor device, said process comprising:

forming a pair of adjacent gate stacks in said insulative layer;

forming sidewall spacers on sidewalls of said adjacent gate stacks;

forming a patterned photoresist mask layer over said insulative layer; and,

etching an opening in said insulative layer defined at least in part by said sidewall spacers through an aperture in said patterned resist layer, wherein said opening is etched

through to said substrate using a combination consisting essentially of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, CHF_3, CH_2F_2 and C_3F_8, and wherein the flow rate ratio of said at least one fluorocarbon to said ammonia is from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm.

37. (amended) The method of claim 36, wherein said etching is performed to produce a self-aligned contact opening in said insulative layer, said opening is self-aligned between said adjacent gate stack structures with sidewall spacers.

39. (amended) The process of claim 38, wherein said at least one fluorocarbon and said ammonia are flowed into said reaction chamber such the flow rate ratio of said fluorocarbon to said ammonia is not less than about [2:1] 3:1.

41. (amended) The process of claim [40] 36, wherein said flow rate ratio is within the range of about [3:1] 4:1 to about 10:1.

64. (three times amended) A method of forming a conductive plug between adjacent gate stacks with sidewall spacers and inside a self-aligned contact opening formed in an insulative layer provided over a substrate in a semiconductor device, said method comprising:

contacting said insulative layer with a plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon at a temperature within the range of from about -50 to about 80 degrees Celsius so as to form a self-aligned contact opening

defined at least in part by said sidewall spacers on adjacent gate stacks in said insulative layer without an etch stop, wherein said contacting further forms a protective layer over opposed sidewall spacers which have been formed over said adjacent gate stacks, wherein the flow rate ratio of said at least one flurocarbon to said ammonia is from about 2:1 to about 40:1, and said flow rate of said ammonia is at least about 2 sccm; and,

depositing a conductive plug inside said etched opening such that said conductive plug is separated from said sidewall spacers by said protective layer.